

TECHNICAL NOTES

A SEMIAUTOMATIC MOTOR-DRIVEN
TORSION TESTER FOR LIGHT LEATHERS

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ABSTRACT

A semiautomatic motor-driven torsion apparatus for measuring the flexibility of upholstery and gloving leather is described. The apparatus does not require the operator to determine the starting and stopping points of the test or the rate of twist. Therefore, it is more convenient to use and somewhat more precise than the manual instrument.



INTRODUCTION

Recently a torsion method (1) has been adopted by the leather industry for testing the flexibility of leathers, such as upholstery and glove, whose stiffness in torsion is under 10⁸ psi. A similar method used by this laboratory proved very successful in a study of stiffness in torsion versus temperature and mechanical conditioning (2). The precision of the manually operated torsion tester depends to a significant extent on the operator's ability to judge both the starting and stopping points of the test and twisting rate. The semiautomatic motor-driven apparatus we describe removes the operator judgment required by the manual instrument.

DEVELOPMENT OF APPARATUS

Figure 1 is a sketch of the mechanical design. The base of the apparatus is a triangular steel plate that incorporates three leveling screws and a cut-out for a Dewar flask, for thermostating the specimen. The base plate supports a hollow steel post, and approximately midway on this post is a platform which holds the mechanical components. At the upper end of the post is an overhanging arm with a split bushing and a shaft from which the torsion wire is suspended. A locking screw holds this shaft in any desired angular position, permitting the upper specimen clamp to be turned in a plane normal to the wire for alignment purposes and preflexing of the specimen.

The mechanical components center around a fork with grooved tines in which the lower specimen clamp fits. The fork is rigidly constructed with tines 6.5 inches long. The upper end is bridged with a short heavy-walled steel tube of one inch

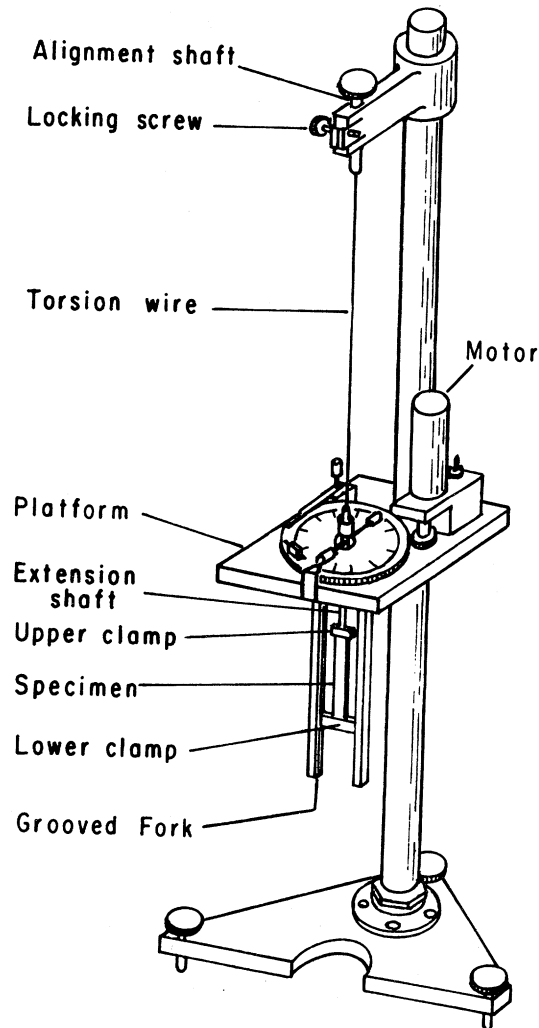


FIGURE 1.—Sketch of apparatus.

internal diameter. This tube rides in a large diameter (45 mm.) ball bearing. The lower clamp and specimen are free to move up and down when the fork is rotated and the specimen twisted. This up and down freedom prevents a tension load's being added to the applied torsion load. The weight of the lower clamp is held as low as possible to reduce the "fixed" tension load. The fork design eliminates the need to make mechanical adjustments when specimens of different length are used.

Figure 2 shows in greater detail the electromechanical controls. A five-inch hubless spur gear is fastened to the upper end of the fork assembly. A one-inch

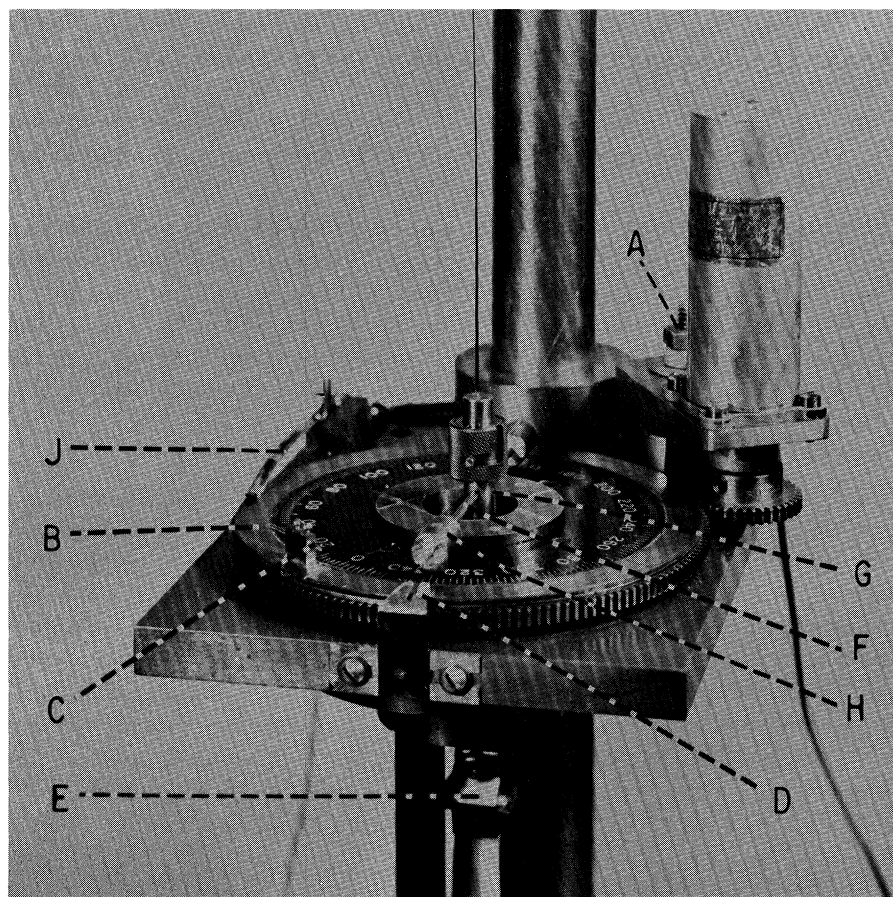


FIGURE 2.—Photograph of mechanical components.

center hole in this gear is the access hole for the upper specimen clamp and its extension shaft.

The spur gear meshes with a 1.25-inch pinion mounted on the output shaft of a geared low speed (ten r.p.m.), high torque (five oz.-in.) DC motor. The end-mounted motor is held to the platform with a single stud (A), around which it can pivot, permitting the spur and pinion gears to be readily engaged and disengaged. Disengaging the spur and pinion allows the fork to be rotated by hand. Friction holds the motor mount in position when the gears are engaged. A regulated and adjustable power supply energizes the DC motor.

The four-inch disc dial, graduated from 0 to 360° in 2° increments, and the copper slip-ring annulus (B), are both cemented to a thin disc of insulating plastic. The contacting pin holder (C) is soldered to the slip-ring, and the pin

is positioned so that its point coincides with the zero line of the dial. A one-inch hole in this dial slip-ring assembly coincides with the access hole in the spur gear. It is fastened to the spur gear with nylon set screws, and four angular adjustments of this assembly are possible. The slip-ring is energized through the slip-ring brush (J), which is a three-inch cantilever of spring bronze anchored to an insulating fiber block on the platform.

The fiducial marker (D) is the reference point for the start and finish of a test run. Upper specimen clamp (E) is linked to the torsion wire by the extension shaft (G). Upper clamp position indicator (F), a brass rod just beneath the torsion wire, is aligned perpendicular to the plane of the upper clamp jaws. The indicating end extends over the slip-ring so that it obstructs the passage of the contacting pin when the latter catches up to it during a test run. Twin weights (H) on the indicator increase its mass, which helps prevent bouncing of the contact.

Essentially, the control circuit is a latching and unlatching arrangement of a relay which controls the start and the stop of the drive motor. Pressing a momentary contact switch latches this relay, thereby starting the test. The test is terminated either when the contacting pin touches the upper clamp indicator or when a manual stop switch, which short-circuits the slip-ring brush, is pressed. Either action activates an unlatching relay in the slip-ring circuit. To provide a safe voltage for the exposed slip-ring, the unlatching relay is operated on 12 volts. A 1.0 microfarad capacitor is connected across the contacting pin and indicator to reduce sparking. For added operating convenience, a reversing switch is included in the motor circuit.

DISCUSSION

The motor-driven instrument was evaluated by comparing its performance with that of the manual instrument. A comparison of the standard deviation of motor-driven versus manual data shows that 80 percent of the time the motor-driven instrument produced less random variability. An "F₀₅" test showed the motor-driven instrument to be significantly more precise five times out of sixteen. A "t" test indicated that there was a significant difference in the averages of the data (bias) in only three out of sixteen test runs. When weighing the above results, one must bear in mind that, whether the instrument is motor-driven or manually operated, the precision of the method is limited to the leather itself.

A test was run to check the effects of different twisting periods (sec./deg.) on the test results. In the limited range from 15 to 6.2 sec./90°, there was no difference in the results attributable to the twisting period. It is likely that periods shorter than 6.2 sec. would make a difference when the torsion wire is twisted beyond 360°.